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HEAVY LOADING AND THE USE OF EXCELSIOR PADS IN THE SHIPMENT OF BERMUDA ONIONS

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Introduction

Prior to the beginning of harvest in the Bermuda onion growing sections of south Texas, the Office of Defense Transportation established a 30,000 pound minimum refrigerator car load for freshly harvested onions. As the previous minimum load for onions was 24,000 pounds, many of the shippers felt that loading 30,000 pounds would result in serious crushing and bruising of onions in the lower layers, and seriously interfere with ventilation in the middle layers. Bermuda onions are shipped in mesh bags containing 50 pounds net and when loaded to the 24,000 pound minimum they were usually loaded five layers high in the car by the method known as "log cabin" loading. An increase to 30,000 pounds meant loading six layers high which would, of course, put increased weight on the lower layers.

In order to determine the practicability of the 30,000 pound load the tests herein reported were made with Bermuda onions shipped in railway refrigerator cars from several south Texas producing districts to New York and Chicago.

During the 1942 shipping season a few shippers had tried padding the floor racks with excelsior as a means of reducing bruising and friction injury to onions adjacent to the floor. The results were encouraging, especially with individual paper-covered pads which produced the desired cushioning effect without blocking air movement through the floor racks between the sacks. As these pads appeared to offer a means of protection from injury which would be particularly needed in the heavy load, the effectiveness of pads on the floor and between layers of bags was made a part of the investigation.

It is well known that weather conditions just prior to and during harvest play an important part in the carrying quality of Bermuda onions. When harvested from wet fields and packed during periods of high atmospheric humidity the onions are much more subject to mechanical injuries and decay than when harvested from relatively dry fields and handled in warm, dry weather.

It so happened that the 1943 harvest and shipping period for south Texas Bermudas, comprising the month of April and the first half of May, was exceptionally favorable for handling onions. No heavy rains occurred during this period and mild, dry weather prevailed almost continuously. This resulted in firm, well cured onions which were relatively resistant to mechanical injury and invasion by decay organisms.

This report should, therefore, be interpreted on that basis. Results were secured under conditions favorable to successful onion shipment and might be quite different under less auspicious temperatures and humidities.

Methods

The plan of the experiment was to obtain two cars for each shipping test. These two cars were to be similarly loaded and routed, the only difference being that in one car the onions would be protected by pads on the floor rack and between one or more layers of onions, and the other car would have no pads. By means of recording thermometers placed in bags in certain positions in each car the effect of pads on ventilation would be ascertained, and by the examination of several bags of onions from pre-arranged positions in each car the effect of the heavy load, and of the pads, on pressure bruising and abrasion or friction injury could be determined.

This plan was modified later, however, to the use of pads in certain stacks in each car with other stacks unprotected for comparison 1/ The reluctance of shippers to load a whole car without pads forced this modification.

Further complications arose in securing comparative temperature records in paired cars due to diversions, reroutings, uncertain rail schedules, etc., so that during the course of the experiment it was never possible to secure records on two cars which moved by exactly the same route and were unloaded at the same time in the same market. However, it is felt that the results, both as to transit temperatures and onion condition at unloading, are of sufficient importance to onion shippers to warrant presentation.

All of the test cars except one were loaded with 600 50-pound bags (log cabin method, 15 stacks of 40 bags each). The exception to this had 400 25-pound bags in one end and 400 50-pound bags in the other end. In this car records were obtained in the end containing the 400 50-pound bags.

Temperature records were obtained by means of Ryan recording thermometers placed inside the bags of onions at loading and removed from the bags when the cars were unloaded. In each car temperature records were obtained at: bottom layer, bunker stack; middle layer, quarter-length stack; and top layer, doorway stack. All test cars moved under "standard ventilation".

The pads used in all tests were paper covered excelsior, 8 inches wide, 24 inches long, and about an inch in thickness when not compressed. These pads were placed on the floor rack in such a way that the full length and contact width of each bottom layer onion bag rested on the pad.

At unloading, bags were taken from definite positions in the car and all of the onions in each bag examined for bruising, friction injury, decay, and sprouting.

1/ In test cars 3, 4, 5, and 6, whose transit temperature records are graphed in figures 2 and 3, pads were used throughout except in and under the stacks described as "no pads" on the graphs.

Results and Discussion

Onion temperatures during transit.

Figure 1 shows the temperatures recorded inside bags of onions at the bottom bunker, middle-quarter and top doorway positions in two cars of onions shipped from Raymondville to New York. One of these cars had pads on the floor rack and between the first and second layer. The other car (Test 2) had no pads on the floor rack and none through the load.

These two cars moved on the same train to St. Louis but one car went out of St. Louis a day earlier than the other and the two cars travelled by different routes on the N. Y. Central Railroad so comparison in temperatures between them is not of much value. It will be noted that the middle layer in the padded car cooled more rapidly in relation to the top layer than in the non-padded car. However, two different types of cars and slightly different loads were involved and the rate of cooling might have been related to car construction or the two sizes of bags in one car. The temperature curves for both cars indicate that ventilation was effective in reducing temperatures throughout the loads to between 40° and 50° F. at time of unloading.

Figure 2 shows the temperature curves obtained in two cars shipped from Laredo to New York. The two cars left Laredo together but PFE 35053 reached New York two days earlier than ART 20542, so again direct temperature comparisons between the two cars are of little value. Onions in the top and bottom layers of the two cars cooled at about the same rate. However, the middle layer cooled somewhat more rapidly in Test 3 than in Test 4. It will be noted that the stack in which the middle layer temperature was taken in Test 3 contained no pads, whereas the comparable stack in Test 4 had pads on the floor and on layers 1 and 2. Therefore it appears possible that the somewhat slower cooling in the middle layer of Test 4 may have been due to the pads but as several other factors are involved no definite conclusion can be drawn. Onions in both cars were between 40° and 50° F. when unloaded.

In Figure 3 are shown the temperature curves for two more cars shipped from Laredo. Both cars were originally billed to New York by the same route but PFE 20464 was diverted to Boston and it is not known when the two cars were separated. The top layer temperature in Test 6 dropped more rapidly in relation to middle and bottom layer temperatures than in Test 5. The top layer temperature in Test 5 was taken in a stack with pads on the floor and on layers 1, 3, and 4, whereas the doorway stack in Test 6 contained no pads. On the other hand the quarter-length stack in Test 5 contained no pads and yet the middle layer cooled at almost the same rate as the middle layer of the quarter-length stack in Test 6 which contained pads on the floor and through three layers.

Figure 4 illustrates the temperature changes which occurred in a car shipped from Odem to Chicago. Temperatures dropped rather slowly in this car probably due to the relatively high outside temperatures during the transit period. The bottom layer cooled to a final temperature of 56° while the top and middle layers reached 62° and 59° F. respectively.

The temperature figures taken as a whole indicate that there was no serious lag in cooling of the middle layer in cars loaded with 600 50-pound bags. There is slight indication that placing pads through several layers of the load reduced the rate of cooling but conditions of the tests were such that no difference can be definitely ascribed to this factor.

Effect of pads on onion condition.

In Table 1 are shown the results of examinations made at time of unloading Test 1 and Test 2. Very little serious bruising was found in any of the bags. It will be noted, however, that onions in the bottom layer of Test 2, which were not protected by pads, showed 2.4 percent badly bruised compared with 0.2 percent and none in the car with pads on the floor racks. These onions were reported as unusually firm for early Texas Bermudas which probably accounted for the relatively small number of seriously injured onions even where floor pads were not used. Both of these test cars contained a substantial number of sprouted onions at unloading which was due principally to the large number of thick necks (associated with imperfect maturity) rather than to loading or transit conditions.

The condition of onions in Tests 3 and 4 is shown in Table 2. In Test 3 the quarter-length stack contained no pads and, as shown in the table, the bottom layer averaged 2 percent bad bruises and 2.1 percent medium bruises which was considerably higher than in the padded bunker stack. Test 4 showed no serious injury in the non-padded bunker stack, but more medium injury than any other lot examined. There is no evidence whatever that pads between layers of sacks had any effect on the amount of injury. The small amount of injury developed in all lots makes conclusions difficult but the data indicate that pads on the floor rack were effective in reducing pressure and friction injury.

Table 3 shows the results of an examination made at the unloading of Test 5. The quarter-length stack in this car had no pads and the results show that the onions on the bottom of this stack suffered more injury than those in any other part of the load. Bad injury to the extent of 6.3 percent was found in the floor bags at the quarter-length without pads compared with 0.2 percent and 2.0 percent bad injury in padded floor bags in the bunker and doorway stacks. As in previous tests there is no evidence that pads between layers of bags were of any benefit.

Test 6 was diverted from New York to Boston which prevented the detailed examination for injury made in other test cars. However, the car was inspected by a representative of the U. S. Food Products Inspection Service who reported as follows:

> "In the bottom layer sacks at the seventh stack, which had no pads, practically all of the onions adjacent to floor racks were bruised, flattened or chafed up to a depth of 1/2 inch. In the other layer sacks (of this stack) we did not find any bruising. In all other bottom layer sacks, which had pads over the floor racks, the onions did not show any noticeable damage when in contact with the pad. Many pads did not shift with the load and, in this case, 4 to 6

Table 1. Effect of pads on condition of Bermuda onions at unloading. Raymondville, Texas to New York, N. Y. April 1943

ART 15037 - Test 1

Position of bags examined		Pads under layer	Total onions examined	Condition at unloading			
				Bruises			
Stack	Layer 1/			Bad 2/	Medium 3/	Decay 4/	Sprouting
			No.	Percent	Percent	Percent	Percent
Bunker	first	pads 5/	430	0.2	2.1	0	4.8
Quarter	first	pads	428	0	1.2	0	8.6
Quarter	third	no pads	200	0	0.5	0	11.5
Doorway	first	pads	341	0	1.8	0	6.7
Doorway	sixth	no pads	216	0	0	0	11.6

WFE 63406 - Test 2

Bunker	first	no pads	976	2.4	1.8	0.5	serious 6/
Quarter	third	no pads	269	0	0	0.8	"
Doorway	sixth	no pads	241	0.4	0.4	0	"

1/ Layers counted from floor up

2/ Onions so severely bruised as to be considered unsalable

3/ Onions bruised 1 or 2 scales deep, but partly usable.

4/ Fusarium and botrytis rots.

5/ Paper covered excelsior, 8 x 24 inches.

6/ No counts made but quantity estimated.

Table 2. Effect of pads on condition of Bermuda onions at unloading. Laredo, Texas to New York, N. Y. April 1943

PFE 35053 - Test 3

Position of bags examined		Pads under layer	Total onions examined	Condition at unloading			
				Bruises		Decay 1/	Sprouting
Stack	Layer			Bad	Medium		
			No.	Percent	Percent	Percent	Percent
Bunker	first	pads	1092	0.2	2.0	0	0.4
Bunker	second	pads	548	0	0.9	0	0.8
Bunker	third	pads	491	0	1.0	0	0.6
Quarter	first	no pads	1022	2.0	2.1	0.1	0.4
Quarter	third	no pads	295	0	1.0	0.7	0.7
ART 20542 - Test 4							
Bunker	first	no pads	864	0	1.4	0	0.4
Bunker	second	no pads	432	0	0.4	0	1.1
Bunker	fourth	no pads	432	0	0.2	0	1.1
Quarter	first	pads	432	0.2	0.9	0	1.1
Quarter	second	pads	216	0	0	0	1.9
Quarter	third	pads	216	0	0.9	0	1.4
Doorway	first	pads	432	0	0.7	0	1.1
Doorway	second	pads	432	0	1.1	0	0.9
Doorway	third	no pads	432	0	0	0	0.9

1/ Bacterial

Table 3. Effect of pads on condition of Bermuda onions at unloading
Laredo, Texas to New York, N. Y., April 1943

PFE 92451 - Test 5

Positions of bags examined		Pads under layer	Total onions examined	Condition at unloading			
				Bruises		Decay 1/	Sprouting
Stack	Layer			Bad	Medium		
			No.	Percent	Percent	Percent	Percent
Bunker	first	pads	400	0.2	1.5	0.2	2.0
Bunker	second	no pads	404	0	0.2	0.5	3.0
Bunker	third	no pads	199	0.5	0.5	0	3.5
Bunker	fourth	pads	199	0	0.5	0	2.0
Quarter	first	no pads	384	6.3	4.0	0	0
Quarter	second	no pads	384	0	0.3	0.5	0
Quarter	third	no pads	409	0	0.2	0.7	0
Quarter	fourth	no pads	202	0	0	1.0	0
Doorway	first	pads	349	2.0	2.0	0.3	0
Doorway	second	no pads	352	0	0.9	0.3	0
Doorway	third	pads	338	0	0.6	0.3	0
Doorway	sixth	no pads	195	0	0.5	0	0

1/ Mostly bacterial, few botrytis

inches at one end of the sack were exposed to the floor racks. In these sacks 2 to 6 onions at the exposed position showed damage. In the fourth stack, which had pads under the lower 3 layers, in comparison to the other stacks we could not observe any difference in the condition of the onions."

No figures were obtained on the amount of bruising or decay in Test 7 which moved from Odem, in the Coastal Bend district, to Chicago. However, representatives of the Department made an examination of the onions, both Yellow Bermuda and Babosa varieties, and reported that the pads on the floor rack were of definite benefit in reducing bruising. The report stated that large onions were more subject to bruising than small ones and those of the Babosa variety suffered more injury than the Yellow Bermudas probably due to the somewhat softer texture of the Babosas. It was further reported that pads between layers were of no discernable benefit in the Bermuda stacks but might be desirable between the first and second layer of Babosa onions. None of the onions examined showed sprouting or appreciable decay.

Summary

Shipping tests were conducted with 7 carloads of Bermuda onions moving from south Texas to New York, Boston and Chicago.

These tests were conducted to determine the effect of the 30,000-pound load on transit temperatures and arrival condition.

The effect of placing paper-covered excelsior pads under the bottom layer of bags and between layers was also investigated.

Weather conditions throughout the entire period of the test were favorable for onion harvest and handling, and onions in the test cars were, by general agreement, firmer and dryer than those shipped most seasons from the same districts.

Onion temperatures in all test cars decreased at a rather uniform rate during the transit period. In most cars onions were loaded at temperatures between 70° and 80° and unloaded at temperatures between 40° and 50°. In the car shipped to Chicago onion temperatures averaged about 60° when unloaded.

No great difference in onion temperatures were found between different parts of the load, indicating that ventilation was reaching the middle layers as well as the top and bottom of the load.

There was no indication that pads on the floor rack affected the temperature of onions in the stack above the pads, and only a slight indication that pads between several layers of a stack interfered with cooling in that stack. Small differences in temperature were not conclusive because of the inability to control other variables such as car type, routing, schedule, etc.

The results indicated that pads on the floor rack were of definite benefit in reducing bruising and friction injury.

There was no evidence to indicate that the use of pads between layers of bags in the load was of any benefit in the shipment of Yellow Bermudas.

Very limited evidence (Test 7) indicated that pads between the first and second layer of bags might be beneficial in the shipment of Babosa onions.

Under the conditions of these tests the movement of freshly harvested Bermuda onions in loads of 30,000 pounds did not result in either failure to cool in transit or excessive injury from bruising or pressure.

FIGURE 1 - TEMPERATURES IN TRANSIT - BERMUDA ONIONS - RAYMONDVILLE, TEXAS TO NEW YORK
ART 15037 - Pads on Floor Rack and Between First and Second Layers - Test 1

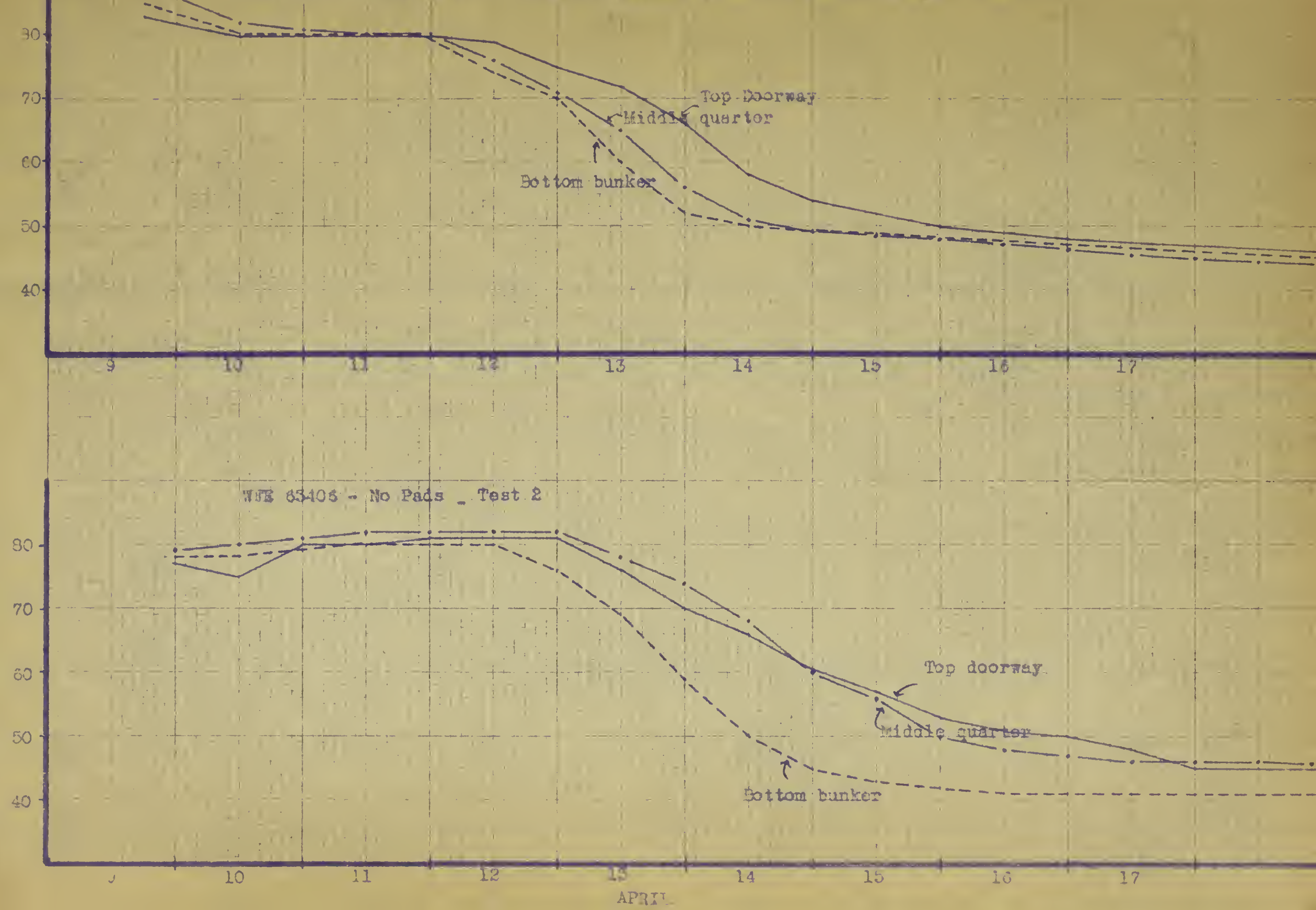
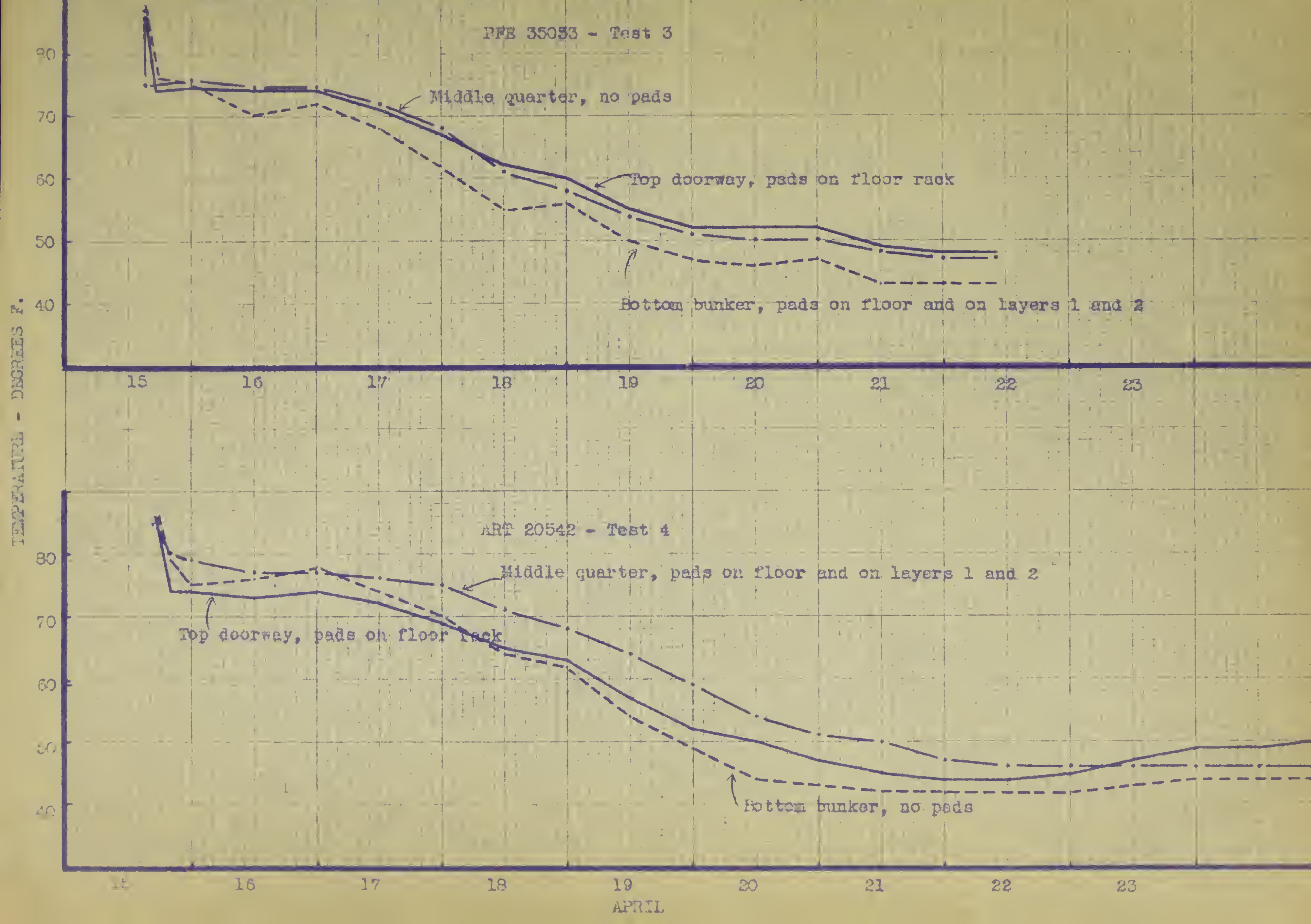


FIGURE 2 - TEMPERATURES IN TRANSIT - BERMUDA ONIONS - LAREDO, TEXAS TO NEW YORK



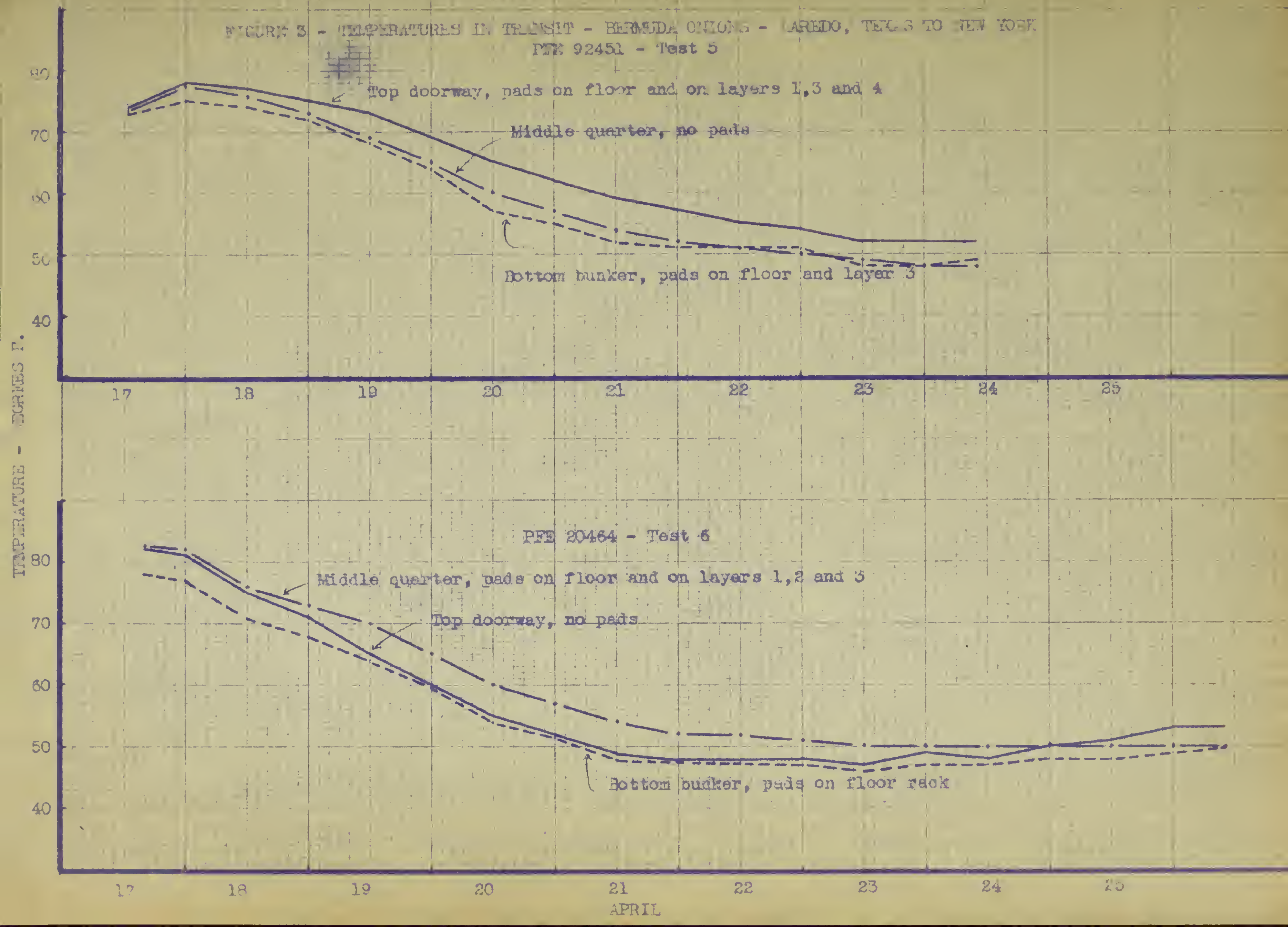


FIGURE 3 - TEMPERATURES IN TRANSIT - BERMUDA ONIONS - LAREDO, TEXAS TO NEW YORK
PFE 92451 - Test 5
Top doorway, pads on floor and on layers 1,3 and 4
Middle quarter, no pads
Bottom bunker, pads on floor and layer 3
PFE 20464 - Test 6
Middle quarter, pads on floor and on layers 1,2 and 3
Top doorway, no pads
Bottom bunker, pads on floor rack
TEMPERATURE - DEGREES F.
80
70
60
50
40
17
18
19
20
21
22
23
24
25
APRIL

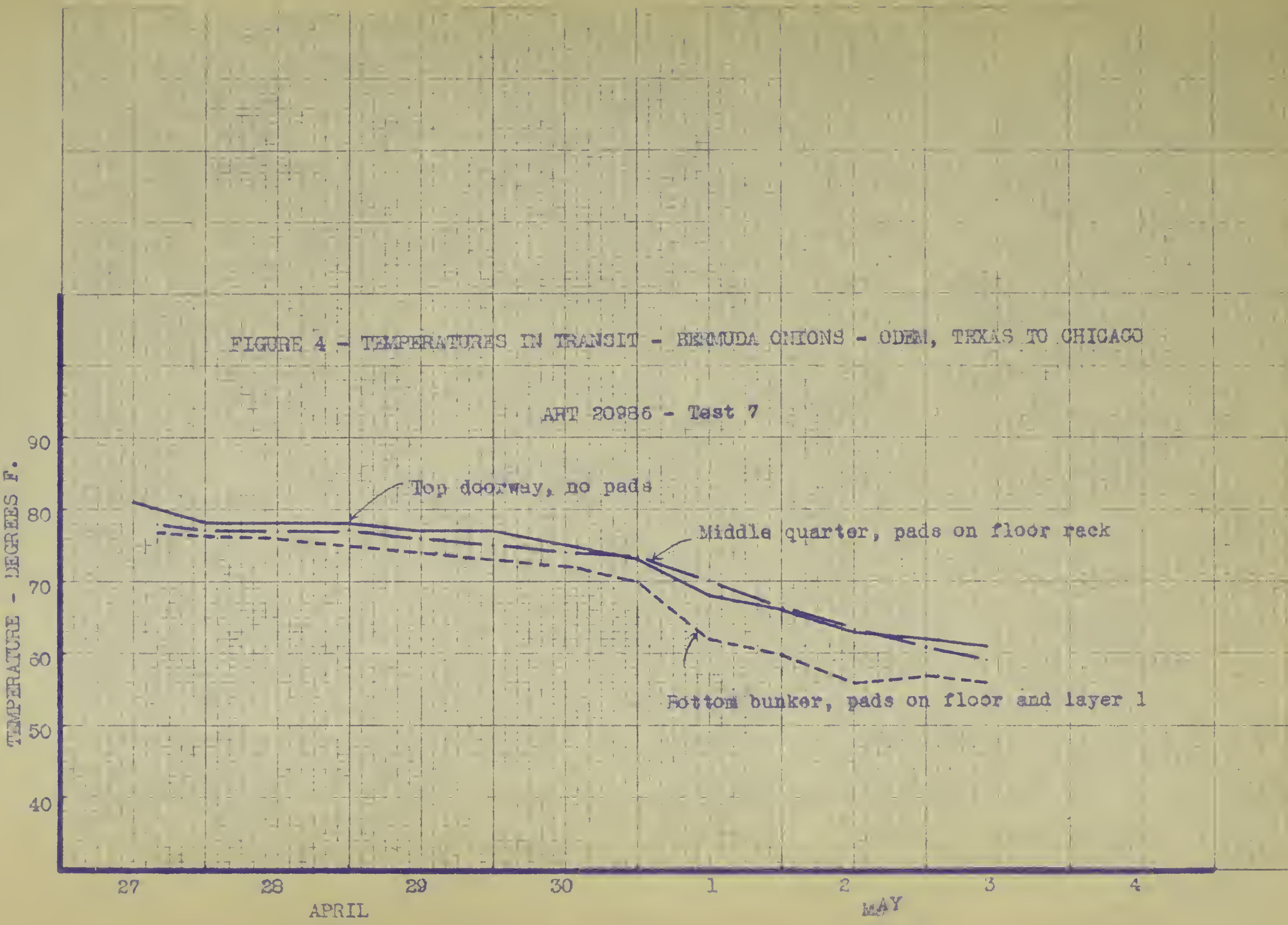


FIGURE 4 - TEMPERATURES IN TRANSIT - BERMUDA ONIONS - ODEM, TEXAS TO CHICAGO

ART 20986 - Test 7